NRC NEWS

U.S. NUCLEAR REGULATORY COMMISSION

Office of Public Affairs Telephone: 301/415-8200

Washington, D.C. 20555-0001 E-mail: opa@nrc.gov

Web Site: http://www.nrc.gov/OPA

No. S-05-007

**ENERGY CHOICES FOR THE SOUTHWEST –
THERE'S NO FREE LUNCH**

Prepared Remarks by

The Honorable Peter B. Lyons
Commissioner
U. S. Nuclear Regulatory Commission

before the

5th Annual Western Energy Summit
Scottsdale, AZ
March 31, 2005

I grew up in southern Nevada and attended the University of Arizona. Thus, returning here tonight is something of deja vu. I recall family trips to Arizona, as well as frequent drives through your Valley of the Sun to the University.

This isn't the same Valley that I recall from years ago. It won't surprise you to know that there are a whole lot more folks here than when I first saw it. I traveled through a Phoenix of 17 square miles, today, the city exceeds 430 square miles. I remember Las Vegas with less than 50,000 people, not the two million there today.

I've watched the transformation of these desert areas into oases with air-conditioned houses, green lawns, and many with swimming pools, to say nothing of endless golf courses.

Your Summit focuses on Western energy needs, and you've picked a topic of immense importance given the spectacular growth in this region. While the annual growth in our country's electricity consumption is forecast to be 1.8%, Arizona's gross state product has grown by almost 7% annually. Your growth rate in electricity is twice the national average, and you've been increasing your use of natural gas by 7% annually.

The water demands of the Southwest are alarming, especially with the recent drought years. Lake Mead has fallen to record low levels, with an 85-foot drop in the last four years. The artesian wells in Las Vegas dried up decades ago, and the translation of the city's name, "the meadows," is probably lost on newcomers today. Short of massive desalination efforts, which require still more energy, it's not clear where the water is going to come from for the next golf course.

The beautiful open vistas of Arizona also mean that you drive a long way between cities. Thus, the five million cars in Arizona require lots of gasoline. But as I wrote this speech, oil was selling at $56 a barrel and gasoline prices were at an all time high. To meet our nation's transportation demands for the next 20 years, our petroleum consumption will increase by 33%, requiring an increase in oil imports of 60%.

Sustainable Electricity Sources

The Senate conducted a hearing last year devoted to discussion of sustainable electricity sources, those sources from which we can reliably forecast new generation for the next century. Witnesses agreed that only coal, renewables, and nuclear energy were candidates. Oil and natural gas were not part of that Senate hearing. While experts argue whether the peak in global oil production is occurring now, or may occur in 20 years, oil is a finite resource.

Supplies of natural gas are better than oil, but still finite. Hybrid cars should delay the day when oil is too expensive to power our cars, but we'll have to switch to hydrogen-, ethanol-, or electric-powered cars within a few decades. Since we don't pump hydrogen from the ground, it will take more energy to generate that hydrogen. Massive use of ethanol would present some major challenges. And if we use electric cars, we need still more generation capability.

Since nuclear energy is on this list of sustainable sources, and since I'll be speaking about it in this talk, I need to note that I'm not speaking to you as an advocate of nuclear power. That is not the role of the NRC as a regulatory agency or the role of my current position, nor can I speak for the Commission itself. Instead, today I speak to you as an "almost native" of the Southwest, who has spent his professional career in national service, and as an environmentalist who has enjoyed hiking, climbing, and backpacking in our magnificent wilderness and desert areas. I also speak as a student of science who wishes to bring its disciplined approach to the considerable challenges which face us as a nation.

Risk/Benefit Tradeoffs

To sustain your population and economic growth into the future, your choices for new energy sources are going to be increasingly confined to those three sustainable sources. And – to remind you of the title of my talk – there simply is "no free lunch" as you make those choices. You'll be faced with the reality that every source of energy brings with it a set of costs or risks as well as benefits that have to be carefully weighed. Tonight, I'd like to talk a little about the tradeoffs you need to make here in the Southwest, and also note that across our nation, all of our citizens will be facing comparable choices.

To varying degrees, each energy source has costs associated with the extraction of fuel or raw materials from the earth, the refinement of fuel or raw materials, and the use of the fuel to produce energy. Also, each may have risks associated with the generation of wastes, the release or control of those wastes, any adverse exposures to people, and the possibility of accidental releases of hazardous materials.

In discussing risk, we must be mindful that most people tend to perceive risk very personally and not always objectively. But from a scientific perspective, properly defined and quantified risk metrics provide a useful tool for comparisons and informed policy choices. The choice of a risk metric can vary, but in every case where we use such metrics, care is needed to ensure a full understanding of the data and assumptions used, the definition of the metric, and the uncertainties in calculating the metric. With that caution, I'll turn to some details on each of those sustainable sources.

Renewables

Arizona derives about 8% of its electricity from renewable hydropower. That source would be hard to expand and may even contract if the current long-term drought continues. Beyond hydro, your use of renewables is very small. In a quick literature search, I was amazed that I couldn't find an operating commercial wind farm in Arizona. I learned that Arizona Public Service (APS) hopes to have its Eastern Arizona Wind Energy Center operating by the end of this year at St. Johns, but at 15 megawatt capacity, that's not much of a dent in your needs.

The best news for renewables is that the fuel, for example the water, sun, or wind, is typically free. But that doesn't mean the electricity is free. Today, solar electricity systems are not competitive with current electricity costs, while wind is getting closer to economic viability. Construction is required, as is maintenance, along with transmission lines to reach markets.

Calculations of the tons of materials required per megawatt-year of electricity for different energy sources are illuminating. Coal requires about 11 tons (excluding the weight of the coal itself), nuclear about 15, wind about 36, and various solar approaches are from about 140 for photovoltaic to 370 for thermal systems.

Both solar and wind power are very low density energy sources, meaning it takes lots of area to collect much energy. You've got lots of open space here in the West, but the requirements still aren't small. One estimate suggests a wind farm equivalent in output to a typical nuclear plant would occupy around two thousand square miles. Wind farms have also raised concerns about visual pollution — which is the notion that "don't build it where I can see it" – and damage to bird and bat populations.

Solar and wind power by themselves can't provide baseload power, the steady relatively constant level of electrical power that drives much of our economy, as opposed to peaking power demands at certain times of the day or year. Both sources only generate about 30% of their capacity just because of their intermittent nature. That intermittence is a real issue, as is the fact that they simply may not be available for days on end depending on weather patterns. Thus, if they become a major supplier of the grid, then backup power sources must also be built and kept ready for operation.

Alternatively, maybe we can devise systems for storing large amounts of energy, then extra renewable capacity could provide energy for storage during their operational times. That's done in some parts of the world now. For example, wind power pumps water into reservoirs in some parts of Scandinavia. In the future, solar or wind power might be used for production of hydrogen, another way of storing energy. But all that will add cost.

Coal

Arizona gets 40% of its electricity from coal plants. While coal plants are becoming cleaner with installation of scrubbers, they still release particulates, sulfur and nitrogen oxides, heavy metals, and radioactive materials. Due to its sulfur oxide emissions, coal is the largest contributor to acid rain in the country. And it may surprise you to know that, for a plant of comparable capacity, a coal plant releases about 100 times more radioactivity into the environment than a nuclear plant, even though both amounts are very low.

A big plus of coal plants is their low cost of electricity generation, just slightly more than the nuclear power plants. But future costs will increase if emissions are fully captured. No serious attempt has yet been made to fully collect carbon dioxide, the primary gas of concern for global warming.

The air pollution from coal plants can be a real issue; a recent study suggests 15,000 premature deaths annually in the U.S. due to airborne emissions from coal plants. It also leads to degraded visibility. This visual pollution, largely from fossil fuels like coal, is of concern in many areas of the country, including your Grand Canyon. Furthermore, coal mining is hazardous and substantial transportation resources are needed to move coal.

As one measure of risk, several groups have studied the life-cycle emissions of various energy sources. In these studies, their conclusions may, at first, seem surprising. For one example, even though reactors don't emit carbon dioxide, mining operations do; thus, on a life-cycle basis, nuclear power is not free of such emissions. Furthermore, these calculations have significant uncertainties and depend on the detailed assumptions made, but they still are useful for general guidance.

One study from the University of Wisconsin shows coal producing more than 1000 tons of carbon dioxide for each gigawatt-hour of electricity, with nuclear at 17, wind at 14, and solar photovoltaics at 39.

A similar Japanese study shows carbon dioxide emissions from wind power to be about 50% more than nuclear power, with nuclear about 50 times less than coal.

Another study from the International Energy Agency shows particulate emissions from coal plants to be as much 660 kilograms per gigawatt-hour, with nuclear a factor of 300 lower and with hydropower and wind a factor of about 120 lower.

Advanced coal plants currently on the drawing board will completely capture all emissions. This effort is led by the DOE FutureGen plant project, but it's far too early to predict the costs or even the feasibility of a plant of this type.

Nuclear Power

Arizona derives 30% of its electricity from nuclear power, and nationwide about 20% of our electricity is from this source. Nuclear power from existing plants is cheaper than from coal plants, but new nuclear plants will be costly. Even though nuclear energy is very capital intensive, several studies show that new plants may be competitive with other energy options.

Nuclear energy, both from our civilian plants and our nuclear navy, has demonstrated a superb safety record. But the public must be confident of their continued safety. Furthermore, with today's fear of terrorism, the public must be satisfied that adequate security is in place at each of our plants. I'll discuss later that my job at the NRC is to focus on safety and security of our plants.

Nuclear power releases minimal airborne emissions, while collecting all of its nuclear wastes for later disposition. Relative to coal, its wastes are very small in volume, well contained, and well controlled. But spent fuel is hazardous and remains so for many years. We currently store spent fuel at reactor sites. While that storage is safe, space for future storage may be limited at some sites. Progress toward an underground repository for spent fuel has been glacial and far behind predictions.

In contrast, some other countries do not plan to dispose of spent fuel, but instead reprocess it to extract and reuse plutonium. That plutonium is an energy resource if it's reused, while if left in the spent fuel and placed in a permanent repository, it is a contributor to long-term health hazards. Reprocessing results in better utilization of the original uranium and less toxicity and volume in the final wastes, but also complicates nuclear non-proliferation concerns. Issues with reprocessing also include cost and environmental impacts.

There are studies underway in several countries to move beyond reprocessing with technologies like transmutation and advanced reactors. That work, if successful and cost effective, would render the final waste products from reactors no more toxic than the original uranium ore after about 300 years and would more efficiently recover the original energy content. But demonstration of these ideas beyond the laboratory stage is well in the future.

It's interesting that concerns over global warming are leading some outspoken environmentalists to recommend further use of nuclear power, in contrast to strong opposition from the "environmental community" just a few years ago. James Lovelock, the creator of the Gaia environmental movement, recently stated: "Now that we have made the Earth sick, it will not be cured by alternative green remedies, like wind turbines and biofuels alone. This is why I recommend instead the appropriate medicine of nuclear energy as part of a sensible portfolio of energy sources."

Radiation Phobia

There's one more risk area, radiation, to which I'd like to devote a little more time. Many people have a strong fear of radiation, maybe because it was first associated with the atomic bomb. They may not be aware that we live in a sea of natural radiation and are exposed to still more radiation through many activities in modern life. Yet, we've clearly adapted to living in this radiation background. For this discussion, I'll be using the term "mrem," a unit of radiation exposure.

In the U.S., the average annual background dose is 300 mrem - not including medical exposures, with very wide variations around the country. If you live at sea level, cosmic rays contribute about 30 mrem each year to your dose, while at higher elevations, like in Leadville Colorado, that dose rises to about 120 mrem. The rocks around you provide more radiation – in the Atlantic coastal plain that only contributes 15-35 mrem per year, while this terrestrial component is about 90 mrem on the Colorado plateau.

There are radioactive materials inside our bodies, and they contribute about 20 mrem annually – which is also the source of some jokes used by nuclear physicists about the dangers of sharing a bed with someone. Naturally occurring radon gas is common around the world. The average annual U.S. dose from radon is about 200 mrem, again with wide variations.

Medical procedures also have historically contributed an average dose of 60 mrem per year, and this dose is estimated to have doubled in recent years in the U.S. Just in the U.S., there are about 180 million diagnostic x-rays annually, along with seven million nuclear medicine procedures.

If we compare background levels around the world, the variation from place to place is more than a factor of 20. Some prominent public places have especially high annual backgrounds, derived from the stone used in their construction. For example, Grand Central Station in New York City at 525 mrem per year is one example. Some hot springs are particularly "hot" in a radioactive sense too – nearby residents experience exposures up to 10,000 mrem annually.

Many activities of daily life also lead to exposures. A cross-country airplane trip adds about 5 mrem, a dental x ray about 6 mrem. Therapeutic medical treatments are typically in the millions of mrem range - but only for the part of the body that is treated.

To compare to a nuclear plant, the average public dose within 50 miles of a nuclear plant is around 0.05 mrem each year. The EPA requires that someone living at the boundary of any future spent fuel repository receive no more than 15 mrem annually. And the regulatory limit at the boundary of a nuclear power plant is 25 mrem per year. Note that these levels are well within the variability of natural background.

There's no doubt that radiation can be dangerous. Short-term exposures to the whole body of 500,000 mrem are typically fatal. At lower doses, cancer is observed in some cases. Cancer can occur after long latency periods, greatly complicating measurement of cause and effect. Further, about 20% of us will die of various forms of cancer quite independent of any radiation exposures, which makes it very hard to determine the origin of someone's cancer.

Health risks of radiation exposure can only be estimated with reasonable certainty at radiation levels that are far greater than background levels. Health effects have been demonstrated only at doses exceeding 10,000 mrem delivered in a very short time.

Also, there is vast uncertainty in any real effects of low doses of radiation delivered over long times. In discussing the question of radiological risk from low doses, the National Academy of Sciences noted that ". . . the possibility that there may be no risks from exposures comparable to external natural background radiation cannot be ruled out. At such low doses and dose rates, it must be acknowledged that the lower limit of the range of uncertainty in the risk estimates extends to zero."

Conclusion

Let me close by noting that the mission of the Nuclear Regulatory Commission is to develop, oversee, and enforce programs to assure that adequate safety and security is maintained in all operations involving civilian nuclear technologies, and assure the American public that their safety is our main consideration. The actions of the NRC, the responses from industry, and the impact of those actions on the public, will influence the role that nuclear power may play in the energy choices that you will make in future years.

I've provided a brief discussion of some of the tradeoffs that must be made to supply our energy thirst in the future. Energy production, just as life, is not risk-free. Each of us needs to carefully weigh options for our activities and understand the risks and benefits of our actions. In the case of energy, I hope these thoughts will help to inform your choices for the energy portfolio that you want to power the West in years to come.

Above all, remember that energy choices require tradeoffs between risks and benefits. There is no easy answer, and there is no choice that is free of risk. Or, as I noted at the start, there is "no free lunch" in energy choices.